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SPINAL SURGERY

A REPORT OF EIGHT CASES

BY
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SURGEON TO ST. LUKE'S HOSPITAL, NEW YORK; PROFESSOR OF SURGERY POST-GRADUATE SCHOOL, ETC

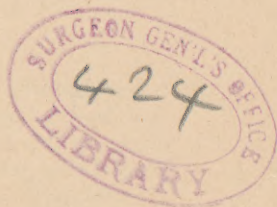
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SPINAL SURGERY—A REPORT OF EIGHT CASES.¹

I HAVE the pleasure of presenting this evening, not a rose-tinted picture of startling achievements of new surgery, but rather a serious review of some of the grave cases of spinal troubles requiring surgical interference which have of late come under my care. They had all been subjected to prolonged medical treatment and were, when referred to me by the physicians or neurologists, in nearly a hopeless condition. Almost as many more cases have been refused operation, but these seemed either to offer hope of relief based on experience, or to give legitimate opportunity for novel operative methods based on sound physiological principle.

The popular idea among physicians has been that the spinal cord is more inaccessible to the surgeon than the brain, by reason of its irregular bony coverings and the hemorrhage from the venous plexuses that envelop it, and that injuries and diseases of it are to be looked upon hopelessly unless nature kindly assumes to work unexpected recoveries. This view is shared even by the public.

It is from the ranks of these doomed cases of paralysis of the lower half of the body and some other spinal troubles that an effort is being made to cull out some cases which, heretofore neglected, may yield good results.

¹ A paper read before the New York Academy of Medicine, May 15, 1890.

A few noteworthy articles have appeared during the past two years reporting operative cases. Those by Horsley, MacEwen, Thorburn, White, Bullard and Burrell, Winslow, Dandridge, and Bennett are of special interest.

It is evident that some cases of improvement have been reported prematurely, and it is fair to ask some months' delay before a published report.

Especial interest has been aroused by the brochure of William Thorburn, of Manchester, just issued, giving, I believe, the most thorough and dispassionate review of this field that has yet been made. While realizing that his most lucid views are based on the study of all cases reported up to the present, one is struck by the fact that these are comparatively few. The need of reporting carefully all cases where operation is done leads me therefore to present the following eight cases which may be divided into four groups.

Three of paraplegia from fracture. One of early curetting of a vertebra for Pott's disease. Two of tumors of the vertebral canal with paraplegia. Two of intradural section of some of the posterior roots of the brachial plexus for neuralgia.

I will read the three fracture paraplegia cases together. The first one was:

CASE I.—*Fracture of the Spine between the Eleventh and Twelfth Dorsal Vertebra, Complete Paraplegia and Anæsthesia with Incontinence; Operation, Eleven Months Afterward, Breaking up Intradural Adhesions; Suture of Dura; Primary Union; no Relief of Paralysis up to One Year afterward.*—R. M. G——, aged twenty-seven, merchant; a gentleman above the average height and in good health until May 19, 1888, when he fell from a platform twenty-one feet high, while pushing off a large beam. Fell with the timber on sawdust-covered ground, receiving scalp wounds, but it is impossible to say whether the timber struck him or not. He was unconscious for three hours, and was completely paralyzed and insensitive be-

low his waist when he recovered. Efforts were made, under ether, to straighten the fracture deformity of the spine by extension and manipulation, but nothing was gained. A bed-sore formed over the deformity and a water-bed was obtained. At first it was filled with very cold spring water, and he suffered such pain on being placed upon it that he fainted and was unconscious for hours. Complete incontinence of urine occurred from the first, and his bladder was irrigated for cystitis. Diarrhœa was succeeded later by complete inaction of the rectum, requiring the persistent use of laxatives.

After three months he resorted to a wheel-chair and attended to business. This was his condition in April, when he was brought from Texas to Dr. Lewis A. Sayre, who referred him to me.

He was in good general condition, though having twelve per cent. of albumin in his urine, which decreased to seven per cent. before I operated. The line of anæsthesia was sharply defined and above it no hyperæsthesia.

April 12, 1889, I operated with the assistance of Dr. Weir. The method pursued being typical I give it in detail and will not repeat it for the other cases. The back was shampooed the evening before and a damp sublimate dressing kept applied until the moment of operation.

The patient was laid prone but with one shoulder raised by a sand-pillow—favoring easier respiration and inclining the back toward the operator slightly. A free incision was made parallel to the spines, and a half inch to one side, cutting the longissimi attachments from one side only, and being carried clean down to the laminæ at the second or third pass of the knife. To approach the fracture between the eleventh and twelfth, the incision was made from the eighth dorsal to the first lumbar spine; the laminæ were then cleared of muscles, which were drawn outward by retractors, and the ligament divided above the spine of the eighth and below the eleventh,

thus isolating a block of four spines, whose bases were then severed from their arches by stout cutting pliers.

This manoeuvre at once allowed a retraction of the entire block of connected spines with their muscles still attached on one side, and the entire breadth of the spinal arch was thus exposed without sacrificing the overlying tissues. A pair of slightly curved rongeurs was then applied to the lower edge of one lamina and with incredible ease the entire breadth was quickly gnawed away. Three arches, the tenth, eleventh, and twelfth were thus treated and the clean spinal cord laid bare for two and one-half inches. The twelfth dorsal vertebra was found to have been displaced backward, the fracture running through the articular facets, the pedicles and laminae. The cord was compressed between the arch of the eleventh above and the upper lip of the body of the twelfth below. The intervertebral cartilage had been ruptured. Above the line of pressure the cord pulsated, below it did not.

In half a minute after the cord was released from its flattened state (the bone pressure area being only half an inch deep) the dura became rounded up as full as it was above or below. When it was filled out there was no surface appearance by which one might say the cord within was not normal, except that the upper portion pulsed. I emphasize this because surgeons so often have reported that the cord appeared normal, therefore they did not open the dura. The wound now being irrigated and dried the dura was slit up for two inches. Adhesions of various densities were found within, attaching the meninges to the dura. They formed a complete circular dam, shutting off the upper from the lower part of the canal. Only an ounce of clear spinal fluid came out, as the spinal canal had purposely been inclined on the table so as to slope with the head lower. The veins of the cord were not distended. The adhesions were, with very little force, broken up.

The cord was normal in thickness above the involved part, then, by a sloping rather than abrupt change, it merged

into a flattened cord for three-fourths of an inch, retaining its breadth but less than half its thickness, the principal atrophy seeming to be in the posterior columns. Throughout this flattened portion the white fasciculi of the cord could be traced continuously, so that there was no abrupt break in its continuity.

Before operating it had been proposed to the patient—whose unusual intelligence and thorough appreciation of his hopeless state enabled me to lay all the possibilities of spinal surgery up to that time before him—that if we found the cord destroyed within narrow limits and apparently sound above and below, we might excise the destroyed portion and suture the fresh cut ends, if in our judgment it seemed wise. Though told it had never been done he accepted the experiment. It proved to be an impossible operation, however, in his case. To judge whether it would ever be possible, I tried to approximate the sound cord on either side of the damaged part by traction made with tenacula, embedded in the meshes of the membranes at such points as would have been available for sutures.

There is a slight latitude of motion of the cord vertically in the canal, and I judged at this trial that I might have excised a scant quarter of an inch, and then approximated the ends by sutures that would not tear out. The damaged cord in this case was three times that length. No further repair being possible the dura was sutured by fine catgut. Then the displaced spines were brought into line and sutured by heavy catgut to their neighbors above and below.

The fascia investing the muscles then received two or three interrupted catgut sutures with gaps for drainage, and finally the skin was drawn partly together by a few catgut sutures not tied, but left for use at the next dressing. No drainage-tube was applied, but a piece of protective three inches wide laid over the wound, the skin edges being left a quarter of an inch apart so as to allow drainage from the deep portion. The investing antiseptic

dressing was covered by a plaster jacket covering only the back, like a turtle shell, and secured by an enveloping canton flannel binder pinned in front.

In forty-eight hours the dressing was changed.

Drainage had been perfect; the wound had healed except the skin, which the sutures, already in place, now brought together when tied, and a final dressing was put on.

From the time of operation he had no pain in the back or extremities. The wound healed primarily, leaving only a linear scar. He remained three weeks in St. Luke's Hospital, with no fever or other disturbance. His condition has been watched since then, and there has been no improvement in motion or sensation.

For six weeks he wrote encouragingly, and claimed that he could draw up his toes an inch and had returning sensations. A recent letter, however, written nearly one year after operation admits that he has gained nothing. Yet in general flesh and mental welfare he has never been better, weighing more than ever, and enjoying life from his perambulator which he wheels about.

About six weeks after operation he passed through a curious two months' illness of the nature of trance. He writes me that he began by having severe pain in his feet and legs every morning, then became unconscious after two weeks and remained so, yet seeming to be in pain while thus sleeping. Soon he became calm and slept constantly, sometimes answering questions and some times not understanding; but he seemed to know who was about him, and would usually tell. He came out of this abruptly and was in every way mentally himself again.

I judge this to have been an effect left by reaction after two months of exalted excitement and harboring the "exhilarating sentiment of hope," followed by swift appreciation of the unchanged paralysis, and that it is only one of the curious hysterical manifestations occasionally connected with spinal disturbances.

CASE II. *Fracture ; Paraplegia below Eleventh Dorsal, Two and One-half Years' Duration ; Operation.*—G. W. I—, aged twenty-seven, merchant. In October, 1886, the patient was thrown from his horse on his ranch in Montana, and struck his back across a stick on the ground, injuring the spine at the junction of the dorsal and lumbar vertebræ. Instantaneous and complete paraplegia resulted below the waist, with paralysis of the rectum and bladder. He lay where he fell for a day and a half before he was discovered, during which time he was exposed to sleet and snow. When he was found he was taken to a farm-house and the nearest physician was summoned from a distance of ninety miles. During his exposure of a day and a half he had no food or drink. He had an over-distended bladder, but before the doctor's arrival he devised a method of his own for relieving his bladder by means of straws, the ends of which were rendered smooth by dipping in candle-wax. As a restorative after arriving at the farm-house, bottles of hot water were applied to his feet—so hot as to cause blistering, which resulted in gangrene. After three weeks he was removed to his home in Connecticut, where it was found necessary to amputate both legs below the knees. The bladder was catheterized for a week after the accident, but subsequently emptied itself when full without his control or knowledge. Rectal movements were also involuntary. Subsequently he suffered from severe sacral bed-sores. The paralyzed limbs often had a sense of burning and severe pain. Bending the knee forcibly caused pain, and at the time the legs were amputated, no anæsthetic being supposed necessary, the sawing through the bones caused intense pain.

His general health recovered so that he was able to be placed in his carriage and driven about. Indeed he was constantly in the habit himself of driving, of which he was very fond, being secured in the wagon seat by straps.

A few months before he came under my care, which was two and one-half years after the accident, he had un-

wisely remained in his buggy about seven hours. His anæsthesia rendered him unconscious of discomfort from prolonged pressure and there resulted a large area of pressure gangrene under each buttock. The resulting pressure sores refused to heal and thereafter he was confined to his back. His condition became so desperate that life had little in it for him, and he had even threatened to shoot himself if left alone. With the hope that some method of operation might be devised for his improvement he was brought to me at the Post-graduate Hospital by Dr. Smith, of Meriden, Conn. Examination showed absolute paraplegia and anæsthesia below the line crossing the sacrum at its upper border and extending in front across the abdomen two inches below the navel. The bed-sores under the buttocks were unhealed, exposing the bone. There was involuntary muscular jumping in both legs. Urine showed granular casts, but no albumin. The patient had strong and natural erections with emissions.

He was examined by Dr. Dana, whose conclusion was that the cord was absolutely severed at the last dorsal, but that below the second lumbar it must be in fairly healthy condition.

The case seemed absolutely hopeless unless it were possible to innervate the lower segment of the cord by renewing its contact with the upper, or, what seemed not impossible and perhaps worthy of trial, to carry out a suggestion of Dr. Dana's, in case the parts were not too much injured, "to cut off a few of the lower dorsal roots long and of the lumbar roots short and suture them together, thus increasing the chance of getting sensation.

The man's hopelessly bed-ridden and suffering condition led him to urge us to any operation, however novel or dangerous, that offered the slightest chance of improvement. I therefore operated, April 18, 1889, at the Post-graduate Hospital, by the same method as detailed in former cases. An incision was made from the ninth dorsal to the third lumbar vertebræ, and the spines of the tenth, eleventh, and twelfth dorsal and first lumbar were

clipped from their arches and drawn aside with attached muscles, exposing the entire spinous arch. It was then found that a massive and dense eburnated deposit of bone had formed at the site of the eleventh and twelfth dorsal and first lumbar laminae. This was with difficulty chiselled and cut away until the severed end of the spinal cord was exposed and found to be completely cut across and the dura sealed up. Below this, for one and one-half inch, solid bone filled the vertebral canal. The cord here commenced again and its end was found engaged in the bone so that spiculæ had grown into it. It could not be lifted up to approach the upper end more than half an inch, and it was evident repair by suturing was hopeless. The operation had been unusually bloody on account of numerous venous sinuses, which were opened in the bone and the patient was considerably exsanguinated. He rallied fairly well from the operation by thorough stimulation and saline infusion of thirty ounces into the vein of his arm, but died thirty hours after, the kidneys secreting only four ounces of urine during this time.

CASE III. *Fractured Eleventh Dorsal Vertebra; Paraplegia; Operation; Opening Dura; Recovery Unimproved.*—J. S——, aged twenty-seven, coachman. On January 1, 1889, alighting from the rear platform of a "bob-tail" car, while going rapidly, he was struck in the small of the back by the platform, fell on his hands and knees, suffered acute pain in his back, and was paralyzed at once. He was moved in an ambulance to a hospital, and plaster jacket applied for a month. Had incontinence of urine and fæces. His urine was acid and contained a trace of albumin. Had no pain in his legs and paraplegia was complete. Admitted that he could feel when his legs were touched and complained of tingling in both feet and legs. On examination a slight depression was seen between the last dorsal and the first lumbar spines. A line of anæsthesia crossed the back at the top of the sacrum. At the sides it ran one inch above the crest of the ilium and crossed the abdomen two inches

above the pubes, the line following the curvature of the groin along Poupart's ligament. There was atrophy of all the muscles of the thighs and legs. Complete paraplegia and anæsthesia, the skin of the lower extremities showing persistent vasomotor impressions.

February 28, 1889.—Operation under ether. Incision seven inches long from the ninth dorsal to the second lumbar. Operation essentially the same as in the case narrated last. The laminæ of the tenth, eleventh, and twelfth dorsal and first lumbar were removed by rongeurs. The arch of the eleventh dorsal showed evidence of recent fracture, but there was no displacement and no pressure. The dura appeared evenly full and round, and as far as its surface showed nothing would be suspected wrong within it. It was, however, then slit for three inches and a half; from the lower part a little fluid escaped. At a point underneath the injured arch a circular dam of lymph was found, one-eighth of an inch wide, between the dura and the cord, entirely shutting off the upper from the lower part of the canal. From above this dam the arachnoid fluid flowed freely. The cord at this point showed evidence of having been completely crushed, the white substance ending abruptly and beginning again something over half an inch below. In the intermediate space the cord was represented by a pinkish-gray substance, apparently consisting of only the meshes of the membranes, but no white fasciculi. Just below the lymph-dam a mass of largely distended veins occupied the surface of the cord, showing obstructed venous return. These entirely emptied themselves upward when the pressure was taken off and the lymph parted by the probe. The cord was entirely liberated from its adhesions, the dura sutured with fine catgut and the wound closed.

The patient convalesced without fever, the temperature never rose above 99° , and the wound healed promptly with no escape of cerebro-spinal fluid. On the following day, I was surprised to find that the patient had acute hyperæsthesia of all the paralyzed part. A touch or

pulling of the hair on the feet, legs, and thighs instantly gave acute pain and involuntary jumping of the limb. There was absolutely no voluntary motion however. He was able to identify the part touched, as witnessed by Dr. Dana and myself and the House staff.

During the second week, this hyperæsthesia abated, and he was as he had been before. The muscular response to Faradism was improved, but there was no volitional action up to six weeks after operation.

All operators upon cases of fracture paraplegia of any duration have thus far arrived at about the same conclusion—namely, that the pressure of bone is of the most secondary importance, except the fracture involves only the arch, where it is driven in by a blow, inasmuch as the violence, usually a fall and bending of the back, which will produce instant paralysis, has done so by a diastasis of the vertebræ, the cartilage being ruptured and the arches broken, which completely pulpifies the spinal medulla. The vertebræ are very apt to immediately resume their usual relations. If, however, the fracture takes place at or below the last dorsal, where the medulla has disappeared and the firm cauda equina commences, the crushing does not usually destroy the nerves, but long bone-pressure would. In such cases operation to correct it is always desirable. It still remains a problem, perhaps never to be solved, how to connect the lower segment of the cord with the upper when there is a gap of half an inch, and whether this union would restore functional connection with the brain, even though its reflex and independent activity may be ever so good. The cases may yet be found where sufficiently narrow transverse lesions will allow suturing fresh cut ends of the cord.

In other cases it remains yet to try the suturing of nerve-roots from above the break into some one or two below, sacrificing only the cutaneous supply for a small area, as suggested by Dr. Dana, or, as seems feasible, implanting them into the cut end of the lower stump, thus perhaps

innervating some limited portion of the distal end with the chance of stimulating more. Possibly in this way even the vesical control alone might be restored. This is conjecture entirely, and based on the fact that clean-cut nerve-sections will unite.

The next case is one of Potts' disease, taken early and treated as a tubercular caries in any joint would be. The only points of interest are indicated in the report.

CASE IV.—Eugene K——, aged twenty; glass-worker. This case is narrated simply to show the ease with which the vertebral bodies, if carious, may be approached from behind.

Two years before admission the man had had a pleurisy from which he recovered. Subsequently he was cured of a fistula in ano, and when he came into St. Luke's Hospital he had slight phthisical changes in the apex of the left lung, and a lumbar abscess prominent over the iliac crest. The latter was opened in September, 1889, by Dr. Curtis, and discharged profusely through three sinuses around the crest of the ilium.

In February last, I found a long probe passed upward to the last dorsal vertebra, and as there was no deformity and but little pain, I considered the possibility of curetting the carious bone.

On February 5th I incised beside the twelfth dorsal, guided by the end of the probe. The transverse process of the twelfth was carious and was cleared away with a bone curette. This instrument was then worked into the body of the bone alongside the spinal dura, without injury to the latter, and a large excavation of softened bone removed to the extent of about half of one vertebral body, when on every side the curette encountered firm and apparently sound bone; the entire course of the pus-track through the soft parts was curetted and douched with sublimate solution, and finally with solution of iodoform in ether. The wounds were dressed with the usual care. In six weeks the patient was sent from the hospital with only a slight discharge, and with but one sinus.

The course of this case shows that where there are long sinuses connected with a small carious bone-focus the great proportion of purulent secretion is from the sinus walls, uniformly lined with tubercular granulation. It further illustrates the ease with which the excavation and drainage can be accomplished directly backward through one side of the vertebral canal, by pressing the uninjured dura aside.

I now speak of two cases of unusual interest, because they represent a field in which the extreme nicety of diagnosis does credit to the physicians in charge, and surgical relief follows closely.

CASE V. *Extradural Tubercular Tumor of the Spine; Paraplegia Complete; Operation; Recovery.*—I epitomize the narrative of this case, which has already been reported in full at the State Medical Society in Albany one year ago, *New York Medical Journal*, February 24, 1889.

G. P——, aged twenty-two, was taken with pain in his back in January, 1888; came to St. Luke's Hospital in March. The spine was flexible, and without deformity, though a very slight fulness was seen in the soft parts to the right of the ninth and tenth dorsal spines. During March sense of touch was dull in his legs and the muscular power somewhat weakened. A line of hyperæsthesia formed about his waist. Two weeks later he could not stand without support and he had uncontrollable twitchings of the legs, which had become quite anæsthetic. He had constant intercostal pain, with girdle pains about the limiting line of disease. Incontinence of urine and fæces followed. An active hectic set in and he rapidly wasted away. During the week before operation he failed so rapidly that it seemed he could live but a short time.

On May 26, 1888, just two years ago, I operated. Making a free incision I removed the spines and arches of the eighth, ninth, and tenth dorsal vertebræ. Outside the carious arch of the ninth was a half ounce of thick pus, but within, and filling the vertebral canal, was a small

quantity of inspissated pus and a large amount of dense neoplasm—evidently tubercular. It extended up and down the canal for two and a half inches and was thoroughly curetted from the cord by Volkmann's spoon until sound bleeding tissue was left on every side. The cord was firmly compressed against the anterior wall of the canal. The wound was lightly packed with iodoform gauze and allowed to granulate. A plaster jacket was applied over all. On the eighth day sensation began to return in his thighs. In three weeks he began to move his legs and toes. His hectic left him. Pain disappeared at once and appetite returned. In six weeks he moved his legs well. In three months walked with crutches. In five, walked without support, but with an ataxic gait. In eight had become robust and hearty and walked very well.

He resumed work and remained in perfect health for two years, walking as well as ever and without fatigue. Recently, after the confinement of the winter, he has had an abscess form in the cicatrix which had been so long healed, and I have had to curette a sinus remaining from it which led down to the bone. There has been no affection of the cord, however, and I hope very soon to heal the sinuses, though they have a distinctly tubercular appearance.

CASE VI. *Pressure Paraplegia from Extradural Sarcoma; Operation after Eight Months; Resection of Arches of the Eighth, Ninth, and Tenth Dorsal Vertebrae; Complete Removal of Tumor; Death on Ninth Day.*—Professor D. A. MacG——, aged forty-two, of Toronto. The family history of this patient represents an unusually vigorous type and free of any inherited tendencies. He himself a man of excellent physique and with no acquired disease and enjoying exceptional health except for one incident, repeated eight or nine times during as many years, namely that he had vomited dark blood from his stomach, “not at any time more than a teacupful,” and always after some particularly violent exercise, such as

rowing, sawing, or shovelling snow, which caused kneading motion of his stomach. He never regarded the matter seriously and only once sought advice. The last occasion was one year ago.

Three years ago, while placing a pedal under a heavy piano, the instrument was let down and pressed heavily on his back. He suffered pain several days. Six months later, while lifting the corner of a piano he was caught by an excruciating pain in the back and felt as if he had stripped up a piece of muscle from the rib on his right side. No further pain or trouble ensued. About July 1, 1889, he jarred his spine severely, by attempting to spring upon a car platform, but miscalculating the distance, alighted violently on his feet, on the pavement. A week later he again jarred his spine by slipping on an icy place and plunging forward on his hands and knees. These are all the possible sources of trouble known to him. In July, 1889 he first felt a decided, though not severe, pain in his back at the site of the present trouble. His health began to decline. His bowels became difficult to move except by laxatives which it was found necessary to make stronger and stronger. As the days passed on he found it difficult to urinate and by great effort could only partially empty the bladder. A pain, mostly in the right side, centred in the back and a "trickling sensation worked about the line where the girdle of paralysis now is." He kept himself tightly bandaged to relieve pain. He was believed to have muscular rheumatism and as he was losing strength rapidly was urged to take exercise. In two weeks he found it painful to rise and dress, but by effort did so and supporting his back with both hands walked about the house. At the end of five weeks he found himself losing his ability to guide his limbs. His limbs grew weaker and he walked pushing a chair before him for security. He had no temperature, but from sheer weakness he took no exercise for several days. After again being told he must exercise, he made one final effort on the evening of August 23d. He pushed

the chair before him but fell on his side. With indomitable will he made another effort and fell on his back. Then he crawled to a sofa and lay there all night. Immediately thereafter his paraplegia and insensibility were complete. One of his feet was blistered without his knowing it, and retention of urine required catheterization. During two months succeeding he recovered a little control of his bladder and improved somewhat in health.

In October, 1889, he was visited by Dr. E. C. Seguin in consultation. A diagnosis of pressure paraplegia was made, and operation advised. A letter from Dr. Seguin, which I will cite later, gives the ground of differential diagnosis. About January 1, 1890, he came to New York under the care of Dr. R. F. Weir. Drs. Seguin and Weir found on examination a slight fulness of the eighth dorsal spine, and advised a month or six weeks' orthopædic treatment, hoping that the pressure might be from Pott's disease, and that a natural relief of intravertebral pus might soon be expected and the paraplegia cured without operation. Dr. A. B. Judson adjusted a most comfortable spinal brace, and watched his course.

The looked-for improvement did not come. His cystitis grew worse. Absolute anæsthesia was established below the waist. The bowels, which had been constipated, became incontinent. He had a fortnight's illness with acute nephritis, and a temperature of $102\frac{1}{2}^{\circ}$ F. Dr. Weir being now in Europe, he was transferred to my care, as he had directed in case of decline.

March 13th.—On examination his urine now had five per cent. of albumin. The anæsthesia line encircled the body, passed through the navel in front, the second lumbar spine behind, and a line at the sides three inches above the iliac crest. The muscles of the legs were in spastic contracture. The plantar, perineal, patella, and other reflexes were exaggerated. The eighth, ninth, and tenth dorsal vertebral spines were raised a little, and pressure on the right of them gave pain, as did pressure

on the angles of the ribs on the same side. General condition fairly good for operation.

On March 20th, the day before it had been arranged to operate upon him, he had an unaccountable chill, with a temperature of 104° F. Prior to this it had ranged from normal to 100° F. His urine showed twenty per cent. of albumin and various casts.

On March 23d, another chill and profuse sweating. His stomach had rejected food, but soon improved. This attack lasted over two weeks before his temperature fell to normal. There were no pulmonary complications, but deep ulceration of the rectal wall was found, which he said had existed for two months.

This attack, as well as the one of six weeks before, was probably due to a slight septic infection from the rectal ulcer, which now healed under iodoform.

By April 16th he seemed again in fair condition to bear operation, though not nearly as well as before. Assisted by Dr. Weir and Dr. Farquhar Curtis, I incised from the seventh to the eleventh dorsal spines. The arches of the eighth and ninth, as well as the base of the spine of the eighth, were found somewhat crumbly and eroded by a softish dark growth, which disintegrated the bone where it pressed outward from the vertebral canal. The bone was unusually porous in the neighboring parts, not immediately involved in the tumor, and bled freely. On removing the arches of the eighth, ninth, and tenth vertebræ, and the pedicle of the eighth, a firm dark growth was found to fill the vertebral canal, compressing the cord to the left side and flattening it somewhat forward, so that it represented scarcely more than half its normal bulk. The tumor stopped abruptly at the ligamentum subflava above the eighth, and extended downward an inch and a half. It was readily removed by blunt dissection from the dura, which was left with a quite natural appearance. The growth bulged backward between the arches, laterally between the pedicles, which it softened, and forward into the body of the eighth vertebra, and at

the side into the subpleural space. From all of these sites it was removed by Volkmann's spoon. The pleura could be seen to rise and fall with respiration.

Not a trace of pus suggestive of tubercular caries was seen anywhere. The wound was packed loosely with iodoform gauze. No plaster jacket was used. He endured the operation very well and was in excellent spirits for four days, when an occasional hiccough was observed. His wound was in perfect condition, and the packing being removed on the second day, the sides were allowed to fall together.

On the fifth day the hiccoughing became rapidly worse, and he vomited everything except a little milk. On several occasions he vomited a little bloody fluid, such as he had done in former years. His bowels were freely acted upon, and his kidneys were doing quite well, with only five per cent. of albumin in the urine.

Every measure was resorted to to check the hiccough and vomiting. It seems that he was subject to attacks of this at times, and was relieved by soothing his stomach with slippery elm water or gum arabic, both of which failed now. His vomiting continued also. By the eighth day the incessant hiccough and vomiting had exhausted him. His respiration became irregular, pulse intermittent. He became delirious and died on the ninth day. His temperature for the last four days was nearly normal. The muscles of the legs began to react to electricity on the fifth day, the gracilis first, and many others on the sixth day. No return of sensation or voluntary motion, however, ensued. A careful examination of the tumor was made by Dr. J. S. Thacher, who found it to be a round-celled sarcoma, without trace of leucocytes, giant-cells, or tubercular material.

Although this patient died exhausted largely by the hiccough, I suspect there was some morbid condition of the stomach like ulcer. No post mortem examination was permitted, except of the spinal cord exposed in the wound. This was found to have rounded up to nearly its

full size during the nine days that had transpired since operation. The dura was quite natural, and on opening it the cord and membranes looked normal in color, form, and consistence.

Of these two cases, the first may be considered one of tubercular tumor, as that was the essential feature of it. In all probability it only involved the arches of the bone; after its growth in the canal it began to press on the cord. The neoplasm was dense cellular growth, not hypertrophied dura, for that was left when the former was curetted away. The subsequent course of events has left no doubt of its tubercular origin. MacEwen reports two similar cases. My second case is of such special importance, as illustrating the differential diagnosis between myelitis of the cord and pressure paraplegia of tumor, that I take pleasure in incorporating a letter just received from Dr. Seguin relative to that question, and feel that further comments from me are useless.

“ 23 ABORN STREET, PROVIDENCE, R. I.,
May 13, 1890.

“ MY DEAR ABBÉ.—The diagnosis of compression myelitis was arrived at by deductive and exclusive reasoning. The dominant symptom, the ‘signal symptom,’ was the fixed side pain which soon became a lumbo-iliac (?) pain. Then followed a gradually increasing paraplegia, without atrophy (at first), but with great increase of the reflexes. The anæsthesia was secondary during the first few months.

“ Now, this symptom-group (at the end of October, 1889) was suggestive of a myelitis in the involvement of the lateral columns; a spastic paraplegia *plus* anæsthesia. The anæsthesia served to exclude primary sclerosis of the lateral columns. But the initial symptom, the fixed side pain, has, we well know, a very restricted meaning. It is never present in myelitis, or in sclerosis of any system of the cord. It surely indicates an extra-cordal lesion, involving in some way the posterior root or the mixed root

of the nerve which supplies the seat of the fixed pain. I call this the dominant symptom, because it serves to locate the lesion (or the chief and primary lesion) outside the spinal cord at a certain level. This being granted, the other symptoms, which are apparently more striking, viz., slowly increasing paralysis and anæsthesia (the latter subordinate), and great increase of reflexes, would surely point to the existence of a lesion outside the cord, producing steadily increasing pressure on this organ at a limited point or level, leaving a healthy segment of gray matter caudad of the lesion. The diagnosis turns upon the pressure of fixed pain in one side, and also, though with much less logical force, upon the comparatively slight anæsthesia, at a time when the volitional motor impulses were wholly arrested at a given level.

“A focus of central myelitis in the dorsal region would give rise to a paraplegia, with equal sensory or motor symptoms, but probably with greater sensory symptoms; and the side-pain would be absent.

“Having established, easily, I think, the diagnosis of compression of the cord by a growing lesion, the further diagnosis, viz., that of the nature of the compressing lesion, is extremely difficult, and often impossible. In a case which has exhibited external cancerous or sarcomatous tumors, the diagnosis of such a tumor of the dura or bones is not difficult. In cases where signs of pulmonary phthisis are present, or where there is a clear history of injury to the vertebral column, we are warranted in diagnosing some form of ‘Pott’s disease’ with caseous formations. In a syphilitic subject, the question of gummata of the dura mater should be considered. In cases without injury, or phthisis, or syphilis, or external tumors, we can only venture a diagnosis of primary tumor of the dura or bones by exclusion, but this is, after all, guesswork to a certain extent. Usually the tumor is not diagnosed, as happened in the case of Commander J——, where I made a diagnosis of compression myelitis, *probably* from ‘Pott’s disease.’ I do not include in this discussion

those cases in which an evident large kyphos indicates the collapse of the bodies of several vertebræ from 'Pott's disease : ' these are most easy of recognition.

"What I have said of the significance of the side pain will explain why I have always taught that great care should be taken to ascertain exactly whether the sensation in the patient's side (chest, abdomen, or groin) is a true pain, or a sense of constriction. The former has the specific value I have assigned it above, while the latter occurs in myelitis, meningo-myelitis, posterior spinal sclerosis, etc. Either of these symptoms may be uni- or bilateral.

"Let me add it as my deliberate opinion that in cases of compression myelitis, except when due to syphilis and 'Pott's disease,' *improving* under appropriate treatment, an exploratory or curative operation is justified, and should not be too long postponed.

"Sincerely yours,

"E. C. SEGUIN."

Finally, two cases of section of certain of the sensory roots of the brachial plexus for neuralgia present what I supposed to be a unique operation. Soon after its publication, however, the case of Mr. W. H. Bennetts, of London, was published—narrating a similar operation for relief of sciatic neuralgic spasm, by division of the posterior roots of the first, third, fourth, and fifth lumbar, and first and second sacral nerves within the dura. The man was at once relieved of all pain, though the spasms continued and anæsthesia of an extensive distribution in the leg resulted. In a few days this area renewed its power of sensation, though the pain kept in abeyance. On the twelfth day the man died of apoplexy.

This operation was performed on December 24th, and mine on December 28th.

CASE VII. *Intractable Brachial Neuralgia ; Nerve-Stretching, Amputation, and finally Intradural Division of the Sixth, Seventh, and Eighth Cervical Nerves.*—This case

was reported at the State Society meeting (*New York Medical Journal*, February, 1889) and will be epitomized here.

For nearly two years before I operated, the patient, a man, forty-four years of age, had suffered most intense neuralgia of the right brachial plexus, appearing in the forearm and hand. It began the night after a hard day's work putting a zinc lining in a large butcher's refrigerator. It grew worse and more paroxysmal. The hand became disabled and muscles somewhat atrophied. Dr. Dana and others agreed in the diagnosis of ascending neuritis.

Dr. Bull stretched the posterior interosseous and ulnar nerves in the spring following. The pain was no better. The patient begged an amputation, and in July Dr. Bull removed the arm at the deltoid insertion in the humerus. The pain did not abate. The fingers seemed to draw and twist as if still on. He acquired the morphine habit, taking a half-grain hourly to subdue pain.

The possibility of the pain being caused by a tumor or inflammatory process near the origin of the nerve-roots, or of dividing the sensory roots behind the ganglion, as proposed by Dr. Dana, who referred him to me, led to the following operation :

On December 31, 1888, I removed the arches of the fourth, fifth, sixth, and seventh cervical vertebræ and exposed more than two inches of the cord. No tumor or abnormality was felt. I then drew back the roots of the sixth and seventh nerves from the intervertebral foramina into the vertebral canal, made some electrical observations detailed in the previous report, and then cut them across just outside the dura where sensory and motor roots join. The wound was lightly packed with gauze.

Recovering from anæsthesia, he still suffered pain, seemingly in the fingers. This region was supplied by the eighth cervical nerve. Forty-eight hours after the operation I placed the patient prone, under a good light and without anæsthetic, removed the gauze packing and did the following operation : The dura and cord lay in the

bottom of the wound clean and dry. I punctured the dura and split it for an inch and a half, letting out two ounces of spinal fluid. This was painless and produced no appreciable sensation upon the patient or effect upon his pulse.

I now picked up the posterior roots of the eighth nerve within the dura which was at the same level as the seventh outside, and cut a quarter of an inch from it. It gave him exactly the same pain when handled as he had experienced for two years or more, and I hoped we had at last gotten at the root of the trouble. I treated the seventh nerve likewise. Then sutured the dura with fine catgut and closed the entire wound. Immediate union was obtained, better even than by primary suture, and a fine linear cicatrix remains, as you see, upon the patient's neck.

The pain entirely changed in character, though he had considerable pain for the next ten days. It no longer went down into the fingers, but seemed to draw the stump. After eleven days he sat up and stopped his morphine. Pain was even less after this. Yet it was paroxysmal and at times severe. The skin was anæsthetic, completely so, from the acromion process downward on the entire outer sides of the arm. There was partial anæsthesia of the anterior and posterior aspect of the arm and over the shoulder from the middle of the clavicle to the middle of the scapula, while the skin facing the axilla was rather hyperæsthetic. This condition was maintained unchanged up to the present, a year and four months since operation. Another disturbance is of interest. Since the fourth day after the operation the vaso-motor disturbance is shown in the anæsthetic skin, which when pinched remains blanched for two or three minutes and when pricked or scratched becomes suffused and forms wheals persisting ten or fifteen minutes. This condition still maintains. He now thinks he has as much pain as before the operation and has gone back to taking a grain of morphine daily.

CASE VIII. *Intractable Brachial Neuralgia Intracranial Division of the Posterior Roots of the Sixth, Seventh, and Eighth Cervical and First Dorsal Nerves.*—Gabriel Z——, aged forty-five. Patient gives no history of rheumatism or syphilis, but has had malaria at one time.

In the latter part of 1886 he states that he exposed his arm at the window of a street car while he was in a perspiration and he dates the beginning of his trouble from this time. A few days afterward he experienced sharp pains between his thumb and index finger. This grew steadily worse and at length became located on the outer side of his forearm and was accompanied by a feeling of drawing and twitching of the little and ring fingers as well. The pain extended up the forearm. It was intermittent, but of such severity as to cause him to cry out.

After two months he grew weak and nervous, lost his appetite and suffered so much that he had to give up his business.

The attacks were paroxysmal and the sensation described by the patient was that of a "drawing pain," the acute seizure leaving some continuous pain and soreness on the ulnar side of the hand and arm.

In August of the following year his ulnar nerve was stretched by Dr. L. A. Stimson. The pain grew steadily worse, the attacks coming on more frequently at intervals of half an hour. The pain spread over the forearm and hand, and in July, 1888, the ulnar nerve was excised by Dr. Fluhrer. Following this the pain recurred in an exaggerated form, and the nerves of the brachial plexus were stretched in the axilla by Dr. Gerster. The paroxysms became even more severe, coming on every five minutes during the day and every half hour in the night.

After the first operation the forefinger became drawn backward and the forearm wasted. The patient took to morphine in large quantity with only temporary relief.

On February 9, 1889, the patient came under my care. Examination showed him to be a rather intelligent man,

of spare physique. He bears evidence of long suffering and has a haggard expression. His attitude is peculiar; he sits with his head bent forward and his body bent so that his left elbow rests upon his knee, his right hand grasping his forearm, the elbow semiflexed.

At intervals of a few minutes he is seized with violent paroxysms of pain which he describes as of a "drawing" character extending from the fingers up the forearm, as though his fingers were being drawn away from his hand and his hand from his forearm. He has a habit of shouting with these attacks of pain, which have made him a source of dread in the neighborhood of his residence. Grasping his arm he will walk the floor in agony for from three to five minutes until the pain subsides. The night attacks are similar to those of the daytime, although not so frequent. Sleep is of course only fragmentary. Urine showed specific gravity 1.009, no albumin.

The flexor actions of the hand are very feeble. The intrinsic muscles of the hand are atrophied, the thumb and middle finger being constantly in a sweating condition. He can raise his hand to his head. The deltoid is atrophied. Triceps in good condition. Infraspinatus atrophied.

He requires hypodermics of morphine about every two hours to render him at all comfortable—one-sixth of a grain.

On consultation it was thought possible to bring about sensory anæsthesia by operation upon the sensory roots of the brachial plexus.

On February 15th, the patient was etherized and I operated, assisted by Dr. Murray. The neck was shaved exposing the occipital protuberance, and the patient was placed in a semi-prone position on his right side. Incision was made to the left of the spinous processes from the third cervical to the second dorsal vertebra. The laminae of the fifth, sixth, and seventh cervical and first dorsal vertebræ were cut away, exposing the dura. Palpation revealed no tumor or abnormal condition of the cord. The dura was punctured and an ounce of arach-

noid fluid escaped. The dura was then slit up for two and one-half inches. The cord appeared normal except that it was slightly congested. The posterior root of the first dorsal nerve was then lifted with a strabismus hook and divided by scissors close to the cord. The free end was then caught by mouse-tooth forceps and one-quarter inch was excised. The sixth, seventh, and eighth cervical roots were similarly treated. The dura was then sutured with fine catgut. After suturing, the seventh and eighth cervical nerves were then stimulated by a weak faradic current outside the dura, Dr. Dana assisting. Stimulation to the seventh resulted in sharp muscular contraction, the scapular being jerked upward and the arm rotated inward. Current applied to the eighth caused the forearm to be sharply extended.

The wound was then sutured with deep and superficial sutures.

On the following day the patient passed a very comfortable time, using less morphine.

On the second day he had but one hydodermic and slept two hours, taking his nourishment well.

The third day he complained of pain in the shoulder and arm, but had a fairly comfortable day and slept for four consecutive hours.

On the fifth day he had severe pain in his head and some mental excitement; took nourishment well. This day there was recurrence of his sharp attacks.

On the seventh day wound was dressed and he was more comfortable. He was allowed to get up, as it was found impossible to keep him quiet in bed.

On the eighth day he suffered less from pain.

From the ninth to the fifteenth day the old pain continued, though less severe.

At the end of four weeks the patient was discharged in a condition of moderate improvement in the matter of pain.

The morphine habit had been entirely checked.

Two months after the operation I visited him at his

house. He was much improved in general condition and doing well. He still maintained the habit of leaning his head down and seemed to be in pain. He was, however, easily diverted, and if entertained seemed free from paroxysms for considerable intervals. His actions suggested those of a man craving attention and gave me the impression of one desirous of continuing the appearance of suffering. He had entirely stopped the morphine habit and had stopped crying out as formerly.

Examination showed the arm and shoulder appearing as before. The muscular power was unchanged. Anæsthesia seemed complete on the left hand, front, and back up to an inch or two above the wrist, over the entire dorsum of forearm and side and dorsum of upper arm half way above the elbow to the shoulder. Above the middle of the arm to the shoulder there was no anæsthesia.

Dr. F. H. Strong, of Yonkers, under whose care this patient had long been, wrote me that he found him decidedly better, and that he thought the amount of physical suffering which he really felt was now comparatively insignificant.

Soon after this the patient had a severe attack of diarrhœa, and lapsed into a low muttering delirium, showing no evidence of pain while in this condition. For one month he continued to have delusions. He then improved rapidly and commenced having pains in the wrist, though not as before.

Two months subsequently he began again to suffer pain and howled during the paroxysms.

Three months after the operation his mind was perfectly sound, but he complained again of his pain and was despondent but did not scream out.

The subsequent course of his trouble during the year has been a mild type of the same evidence of pain as before the operation. The pain does not now cause him to shout. The anæsthesia remains the same.

Dr. Thacher's pathological report of the resected roots, says: "Inflammatory exudation quite marked at portions

of the surface and less marked at a few points inside some of the roots. The changes are most marked in and around the root of the first dorsal."

The basis for this operation is the fact that sensory conduction is isolated in the posterior root, which is easily operated on within the dura. Experiments recently made by Singer, Horsley, and others, to study the ascending degeneration after this section in monkeys, showed that a speedy and complete degeneration backward into the cord followed the section. This would give the desired destruction of an inflamed or diseased nerve to its very ultimate fibres. In my two cases there has remained all the anæsthesia obtained at the operation. Pain, however, has apparently recurred, though much milder. There is often simulated pain in those who have acquired the morphine habit, but in these two cases I believe it to be genuine. My conviction is that if all five roots had been cut the chance of recurrence would have been less.

It is of interest that in four of the eight cases about two ounces of spinal fluid were evacuated when the dura was cut, but that no disturbance followed. These all recovered. Horsley says the dura is highly sensitive, and that the patient should be deeply narcotized when it is cut. That this is an error is shown by the man who endured a two-and-a-half-inch cut in it without anæsthetic and told me at the time that it was painless.

I cannot end this paper without emphasizing the advantage of the method of operation I have adopted. It is the most speedy, the least bloody, preserves *all the tissues* in and about the spines which are replaced and give firmness to the back as well as preventing a gap that nature must fill.

The incision should be on one side of the spines only, they being cut off and dragged to the other side, exposing the entire arch without dividing the inter-spinous ligament. The only bone-cutting instruments to be used are two narrow rongeurs, one curved, one straight, with a

quarter-inch bite and presenting a flat Gothic arch aspect when the points are brought together. Any saw is dangerous, awkward, and inefficient. The rongeurs are by far the quickest.

While we are not warranted in taking a sanguine view of the results of operation, yet surgery, with its possibilities ever looming up, ought not to occupy the ultra-conservative ground of the past in this field.

The scope of operative work may never be a large one, but it will probably not be as small as heretofore.

